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**Is There an Alternative to Famine Relief?:  
An Example from the Sahel**

by

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**Abstract**

Aid agencies spend large sums to provide famine relief and are typically unwilling to provide project support for long periods. Yet, in at least one case in the Sahel, it would be cheaper to provide a long term subsidy for an existing irrigation project than to provide periodic famine relief.

## **Is there an Alternative to Famine Relief?: An Example from the Sahel**

Over the past three decades, drought and governmental policies unfavorable to the development of food crops have left many Sub-Saharan African countries with food deficits and hungry populations. In years of particularly low rainfall or other unfavorable weather, several countries have been forced to call on the international community to provide relief aid to devastated populations. Famine relief has almost universal support. Television images of starving children in Ethiopia or Bangladesh and internationally broadcast rock concerts have generated sizable privately administered financial resources that supplement traditional bilateral and multilateral aid programs.

Yet, famine relief is extremely expensive. The cost of delivery is often several multiples of the cost of the commodities since expensive modes of transport (including air) are used to move goods quickly to the famine area. An obvious question is whether or not there is a better way to address the problem of famine. In particular, could the resources currently being used for famine relief be employed in a different way to achieve the end of reducing starvation and its associated costs? The argument in this paper is that in at least one case the answer is "yes". By providing a small subsidy to keep an irrigation project in the Sahel in operation, periodic expenditures for famine relief in the area would be avoided. Mali, where the project is located, has frequently received famine relief aid. In the 1980s, Mali received at least 25,000 mt of cereals in every year and a peak of 266,000 mt in 1984/85<sup>1</sup>. In 1984/85 the US supplied a total of 54,100 mt of cereals to Mali for free distribution at a total cost of \$23.7 million, including transport to Bamako. The administrative region, called Dire Circle<sup>2</sup>, in which the project is located, received about 30 percent of US assistance.

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<sup>1</sup>Food and Agriculture Organization, Food Aid in Figures, 1989, Vol. 7, No. 1.

<sup>2</sup> The Circle is an administrative unit in Mali similar to a county. The Dire Circle is located in Northern Mali along the Niger River.

In 1979, USAID began financing an agricultural development project in the Sahelian zone of Mali called *Activites Paysannes* (Small Farmer Activities) with the goal of helping farmers in the Dire Circle to increase their irrigated acreage and food production through the use of small diesel-fueled irrigation pumps drawing water from the Niger river. Although famine relief was not a central goal of the project, it was a major unintended side effect. During the 1986-87 agricultural year, for example, the project supported 373 farmers who produced approximately 1,500 mt of wheat, millet, and rice on 800 ha of land. The same number of farmers would be able to produce only 400 mt of grain in a year of good rainfall using traditional farming and irrigation methods, and almost nothing in drought years<sup>3</sup>.

AID support for the project was scheduled to terminate at the end of 1988. AID and Africare, the US private voluntary organization managing the project, had hoped that the project would be self-supporting by that time and they could turn the project infrastructure and administration over to local farmers and cooperatives. However, the literacy rate in the area is very low, and management skills limited, and it became obvious that the project would collapse if foreign assistance were withdrawn. The immediate question AID asked of proponents of additional project financing was whether the project could generate an adequate return to a proposed additional financing of \$1.5 million over three years. There are two related, potential reasons why the project might not be able to meet AID's goal of an adequate return. First, the costs of additional crop production generated by the project might be more than the value of the additional crops. Second, external managerial support might be necessary to run the overhead operations and could not be covered out of project revenues. The question not posed by AID was whether any subsidy necessary to keep the project operating would be greater or less than the cost of the periodic famine relief that would result if the project ended.

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<sup>3</sup>Crystal, Charlotte, 1981, An Analysis of the Socio-economic Factors Which Distinguish Innovators from Traditional Farmers in the Action Ble Dire Project, (unpublished report), Bamako: USAID/Mali, p 45.

The answers to these questions require three steps. First, with the additional \$1.5 million investment, would private profitability for the farmers involved and the project administrative structure be greater than zero? If not, the farmers would have no incentive to participate, and the project would collapse without an explicit subsidy. Second, is the project socially profitable; that is, does the project make a contribution to national income (valued at social prices) greater than the \$1.5 million investment?<sup>4</sup> If so then a case can be made for continued government or AID support of the project, even if the project is not privately profitable. Third, if the project can be made privately profitable after the \$1.5 million investment only with an ongoing subsidy (perhaps to fund outside managerial support), is the cost to the donor agency of providing this subsidy greater or less than the cost of providing periodic famine relief? It is these three questions that this paper addresses. In the first section, a brief description of the project is provided. The next three sections provide answers to the three questions posed above. The last section provides a summary and some additional remarks.

### The Activites Paysannes Project

Activities Paysannes, a small-scale pump irrigation project, is located near the town of Dire in the Lacustrine Zone of the Inland Delta of the Niger river.<sup>5</sup> This Sahelian zone receives an average annual rainfall of only 200-300mm which is just barely enough to support rainfed crops with low water requirements such as millet. The farmers supported by the project irrigate land within a 44 km radius of Dire which is located in the Sixth Region of Mali. Tombouctou, 60 miles to the north, is the capital of the Sixth Region.

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<sup>4</sup>The term "social profitability" is used here in the sense of "economic profitability" as used by some international organizations. In other words, distributional and externality effects are not included in the analysis. The first-best solution for the government of Mali would be to remove the distortions that cause private and social prices to diverge. However, we assume that such a change is not likely.

<sup>5</sup> The Lacustrine Zone derives its name from several large lakes formed by floodwaters of the Niger river. Sand dunes channel the floodwaters into the lakes (Moris, Norman and Thom 1984).

Farmers have been irrigating from the Niger River and its branches in this area for several hundred years. Traditionally they used calabashes (large hollowed-out gourds) attached to ropes to lift the water from the river to canals which conducted the water to their fields. Fields are irrigated mainly in the dry season (December to March) when the river's crest provides abundant water and cooler temperatures allow temperate zone crops, such as wheat, to be grown. Rainfed agriculture is practiced during the rainy season (July to October) and the main crops are millet, sorghum and rice. The rice is often planted in marshy or low-lying areas which collect rain and river water and hold it for a few months.

The 1970s and 1980s brought years of drought which greatly decreased the region's agricultural output. The Niger river, which normally floods vast areas of lowlands, did not reach accustomed levels. Water dried up quickly in the many branches and tributaries of the Niger from which irrigation water is lifted. For example, the Niger's maximum level at Dire in 1984 was only 3.75 meters, the lowest river level since 1966. Rainfall was also insufficient to produce non-irrigated sorghum and millet. Yearly rainfall in Dire from 1980 to 1986 varied from 79 mm in 1982 to 293 mm in 1981. Normally, at least 200 mm of rain falling at the most opportune times is required to produce millet.

It was in this environment of minimal water supply and low production levels that small motor pumps were introduced into the Dire Circle in 1979 by the AID-funded predecessor to *Activites Paysannes* - the "Action Ble-Dire" (ABD) project. ABD was originally funded for \$4.0 million under a "host country" arrangement which specified that the Government of Mali would administer the project with support from USAID. The project was approved in 1978, and implementation began in 1979. ABD was to supply 250 five-horsepower diesel-fueled Cooper pumps purchased in India to local farmers on credit. The farmers were to use the pumps to irrigate wheat fields during the dry season, and millet and rice fields during the rainy season. The project also included a revolving credit fund for short-term financing of agricultural inputs, a mechanic's



workshop and eight mechanics to repair the pumps, and improved agricultural research and extension services<sup>6</sup>.

Problems plagued ABD from the beginning, and the project was never able to meet its goals. "...Action Ble-Dire's involvement as the executive agency became so problematic that in January 1981 USAID froze further disbursement of funds..."<sup>7</sup>. In September 1982 the project was reorganized and renamed Activites Paysannes. USAID hired a contractor and used Peace Corps volunteers in an effort to improve project performance so that USAID involvement could be phased out and the project officially handed over to the Malian government.<sup>8</sup>

The participation of Peace Corps volunteers ended when the two-year contracts of the initial volunteers were completed, and in 1983 USAID called in Africare to complete the phase-out. However, the expatriates employed by Africare and the local farmers began to improve the efficiency of the project. After several years of difficulties, production was increasing and loans were being repaid. This turnaround in project performance encouraged USAID and Africare to

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<sup>6</sup>Moris, John, Ray Norman and Derrick Thom, 1984, Prospects for Small-Scale Irrigation Development in the Sahel, Water Management Synthesis II Project Report 26, Washington, D.C.: USAID; 81-3.

<sup>7</sup> Moris, Norman, and Thom, op.cit.

<sup>8</sup> From here, the history of the project becomes sketchy, but two journalists who made several short visits to the project, provide a colorful description of what happened during this phase-out period in their book Squandering Eden.

Farmers prospered under the worst conditions.... Since farmers made their own decisions, they cut short the middlemen who once controlled them. Profiteers lost leverage. Authorities sensed a slippage of power. For the first time, farmers complained when outsiders stole their fuel money and credit payments. One traditional chief, with the most to lose, lined up support against the cooperative. [The consultant] seeking help from sympathetic military commanders and USAID, was caught in the middle. The battle was colorful and swift, an intrigue-laced struggle with "feticheurs" practicing witchcraft and "marabout" calling on Allah. In the end, [the consultant] was quietly removed from Mali (Rosenblum, Mort and Doug Williamson, 1987, Squandering Eden: Africa at the Edge, San Diego: Harcourt, Brace, and Jovanovich, p. 689) .

fund a one year extension. Further improvements in the project's operations led to an agreement for three more years of funding, through 1988.

Analysis of the project is complicated by the fact that it has two, essentially separate components - the Ganganiberi (GG) cooperative that manages three large pumps, and 60 farmers (called individual member or IM farmers) who purchase services and borrow money from the project for operating small pumps on their private plots. The land of the GG cooperative has been divided into 340 half hectare plots, and most farmers cultivate a single plot, although a few farmers have one to two hectares. During the 1986-87 wheat season, 313 cooperative members worked 170 ha. Membership in the cooperative brings access to the land irrigated by the pumps. Farmers can be dropped from the cooperative for not paying cooperative fees and lose access to cooperative land.

In the 1986-87 wheat season, a typical IM farmer owned one small pump and planted four ha of wheat. IM farmers also grew irrigated millet and rice during the rainy season. IM farmers usually cannot cultivate their expanded areas alone and thus hire daily labor to help with the more time consuming tasks and/or organize various share-cropping arrangements with non-pump owners.

To assure sustainability and stability of food production, a permanent project administration mechanism must be developed to manage the project components put in place by Africare, and fees must be collected from the GG cooperative and the IM farmers to pay for the project services. The four main elements required for sustainability of pump irrigation are:

- 1) the mechanic's shop with trained mechanics capable of repairing most pump problems,
- 2) the credit system which offers short-term loans to farmers for diesel fuel, engine oil and spare parts, and long-term loans to purchase new pumps,
- 3) a logistics system capable of procuring and distributing those essential inputs, and
- 4) an administrative structure which can support the other three.

### Mechanic's Shop

Mechanics and a mechanical shop are necessary to support the diesel fueled pumps in the Dire region. Farmers have learned to perform routine maintenance on their pumps, but mechanics are needed to diagnose specific problems and replace parts. In 1987, nine mechanics worked at the project's workshop under the supervision of an expatriate chief mechanic. The mechanics work on project and private vehicles as well as project pumps brought in from the field. The workshop also stocks spare parts in anticipation of pump breakdowns. In addition to the shop, privately employed mechanics with basic skills live in villages close to IM farmers and make minor repairs. One mechanic usually serves several farmers. The GG co-op also employs a mechanic to perform routine maintenance and simple repairs on its three large pumps.

### The Credit System

The AP credit system provides the means by which farmers procure diesel fuel, oil and spare parts for the two agricultural seasons. Farmers repay these loans at the end of each fiscal year, either through the GG cooperative or directly. The credit fund operates so as to make a profit from the sale of diesel fuel and oil, and the profit is turned back into the revolving credit fund. The project also has limited credit facilities available for IM farmers who need loans to buy new pumps, but does not have the funds to support pump purchases by farmers not already in the system. Without credit, most farmers could not finance the inputs necessary for pump irrigation and irrigated areas would quickly decline since alternate sources of credit are extremely limited.

Although a large portion of the wheat harvest is sold in bulk to repay input loans, farmers also sell part of their harvest in small amounts in local markets. In this way a farmer can sell a few "sawals" (a local volume measure equal to approximately 3.5 kg) every few days as money is needed. Local markets, however, are not capable of handling the large quantities that must be sold

quickly for credit repayment by the June 30 deadline and most wheat is purchased by traders from Tombouctou or Gao.<sup>9</sup>

### Logistics System

A logistics system is necessary to ensure the timely procurement of diesel fuel, engine oil and spare parts. These inputs must be ordered, stored and maintained while in storage, and detailed records of all transactions kept. The inputs are disbursed to farmers in conjunction with the credit system.

### Administrative Structure

A project administrative structure is necessary to serve as a liaison between the project and outside agencies, to coordinate the activities of the various IM farmers, the cooperative, the credit system, and the workshop and to assure the maintenance of infrastructure such as buildings. The project administrator acts as the project spokesperson and handles problems and disputes as they arise. The management of these activities is complex and demands skills that require some time to acquire.

### 1. Is the Project Privately Profitable?

For farmers in the project area, the cooperative, and the project administration, private profitability determines the continued existence of the project. If any one of these groups does not at least cover its costs, the project will collapse. To answer this question, private profitability is examined at two levels - the IM and cooperative farmers, and the \$1.5 million USAID investment. For the farmer profitability analysis, the \$1.5 million investment is treated as a sunk cost, and that this one time investment will allow the farmers to maintain production at fairly high levels over a twenty-year period (the project life). Profitability at the second level (defined as a 12

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<sup>9</sup>Before the 1987 system the project took loan repayment in kind at the government-supported price, typically reselling it in Bamako. A large influx of food relief grains in 1986 pushed market prices below the support price and the project was forced to sell stocks at well below the support price. As a result in 1987, the project ceased to accept in-kind payments.

percent rate of return) was required by USAID as a precondition for making the funds available.<sup>10</sup> While repayment will not actually be undertaken and the funds presumably used as a reserve, the ability to generate that level of return is necessary if the project is to receive the \$1.5 million investment.

Before 1989, farmers received all non-water services (mainly administrative and managerial services) from the project free of charge. If the project is to be self-supporting, farmers must bear these costs themselves. Obviously, the level of assessment for these costs has an important bearing on the profitability of the different components of the project. A variety of allocation schemes could be implemented. However, we assume that the administrative fee is set so that farmers' fees will pay for project personnel (coordinator, logistics specialists, stock manager, credit manager, etc.), office supplies, and maintenance of buildings and vehicles. It is assumed that the profits earned from the sale of diesel fuel and oil will finance the expenses of transportation of fuel, loan defaulters, and maintenance of cisterns and stocks. The mechanics shop will be self-supporting from work on pumps and vehicles. These overhead costs are charged to participating farmers on the basis of cultivated area.<sup>11</sup>

As can be seen from Table 1a and 1b, net benefits to both QG and IM farmers are substantial.<sup>12</sup> If the assumption is made that land has no value, the return to family labor is 840 CFAF per person-day for GG farmers and 1,150 CFAF per person-day for IM farmers.<sup>13</sup> In

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<sup>10</sup>The "market" and social rates of return on capital are assumed to be 12 percent.

<sup>11</sup>The fee for project services is included in "co-op fees" for GG farmers and in "other" for IM farmers in Table 1a and 1b.

<sup>12</sup>Yields for IM farmers are higher than those for GG farmers because IM farmers have direct control over water deliveries to their fields.

<sup>13</sup>This calculation excludes family labor employed in bird control since such labor is not hard manual labor and can be done in conjunction with other activities.

contrast, daily wage rates are only 500 CFAF per day with meals (or 700 CFAF per day including the cost of meals provided).

Table 1a: Annual Average Costs and Returns per crop for a 1/2 hectare farm run by a GG farmer (000 CFAF).

	Wheat	Millet	Total
<b>Costs</b>			
Cooperative fees	27.0	15.1	42.1
Seeds and Tools	10.0	3.0	13.0
Labor	16.0	9.2	25.2
<b>Total Costs</b>	<b>53.0</b>	<b>27.3</b>	<b>80.3</b>
<b>Gross Returns</b>	<b>93.5</b>	<b>60.0</b>	<b>153.5</b>
<b>Net Benefits<sup>1</sup></b>	<b>40.5</b>	<b>32.7</b>	<b>73.2</b>

Notes: Farm size is 1/2 hectare. Average yields are 2.2 mt/ha for wheat and 1.6 mt/ha for millet. Average long run market prices are 85 CFAF/kg for wheat and 75 CFAF/kg for millet. Details are provided in a data appendix available from the authors.

<sup>1</sup>Net benefits are returns to land, capital, family labor and management.

Table 1b: Annual Average Costs and Returns for a typical IM farmer.

	Wheat	Millet	Rice	Total	1/2 ha. equiv.
Area planted (ha)	4	2	1	7	
<b>Costs (000 CFAF)</b>					
Pump-related costs	240.1	81.2	31.8	353.1	50.4
Seeds and tools	63.0	3.5	4.3	70.8	10.1
Labor	132.0	38.0	10.0	180.0	25.7
Other	53.8	28.8	13.4	96.0	13.7
<b>Total Costs</b>	<b>488.9</b>	<b>151.5</b>	<b>59.5</b>	<b>699.9</b>	<b>99.9</b>
<b>Gross Returns</b>	<b>884.0</b>	<b>300.0</b>	<b>172.0</b>	<b>1356.0</b>	<b>193.7</b>
<b>Net Benefits<sup>1</sup></b>	<b>395.2</b>	<b>148.5</b>	<b>112.5</b>	<b>656.1</b>	<b>93.8</b>

Notes: Average yields are 2.6 mt/ha for wheat, 2 mt/ha for millet, and 2 mt/ha for rice. Average long run market prices are 85 CFAF/kg for wheat, 75 CFAF/kg for millet, and 86 CFAF/kg for rice. Details are provided in a data appendix available from the authors.

<sup>1</sup>Net benefits are returns to land, capital, family labor and management.

A single year calculation does not capture the effects of changes in costs associated with replacements in capital equipment and other irregular expenditures that farmers and the cooperative would face. Therefore we have calculated internal rates of return (IRRs) and net present values (NPVs) based on incremental benefits and costs for a 20 year span (Table 2). If the project is not

funded, it is expected that IM farmers and the GG co-op will be forced to pump-irrigate smaller areas since fuel, credit, mechanics, and other project-supported inputs will be less available. Total net benefits per farmer will be thus reduced, although not to the level of production existing when there were no pumps.<sup>14</sup>

With base case values for prices and yields, both GG and IM farmers earned positive net present values (NPVs) on their personal investments in irrigation pumps, seeds, labor and time indicating that they earned a rate of return greater than 12 percent over the 20 year analysis period (Table 2). With higher prices, they do even better. With yields that are only slightly lower than base case, however, private profitability becomes negative, indicating that high productivity is important to cover the cost of the modern inputs.

Table 2: Incremental Returns to GG and IM Farmer Resources Invested in the AP Project

	GG		IM	
	NPV	IRR	NPV	IRR
	(mill. CFAF)	(%)	(mill. CFAF)	(%)
Base Case	25.1	*	1.39	224
Lower Yields	-52.9	Neg	.01	21
Higher Prices	76.5	*	3.40	*

Notes: Base yields and prices as in Tables 1a and 1b. Lower yields are 80 percent of base yields. Higher prices are wheat: 105 FCAF; millet: 105 FCAF; rice: 135 FCAF. Details are provided in a data appendix available from the authors.

\* Not possible to calculate IRR because stream of net benefits is all positive.

At the project level, which combines returns to the farmers, the cooperative, and the project administration, the internal rate of return (IRR) on the total \$1.5 million investment was negative and the NPV was -230 million CFAF. The farmers rely on the existence of the project and the

<sup>14</sup>For this analysis it is assumed that if the project is not financed, IM farmer area cultivated and net benefits will fall 10 percent from 1988 levels in 1989, an additional 20 percent in 1990 and an additional 30 percent in 1991. In the fourth and fifth years after the project ends, areas cultivated will decline an additional 10 percent each year. Thus, by 1993, areas farmed by pump-owning farmers will be 40 percent of 1988 levels. For the GG co-op, some farmers will be able to continue pump farming with the co-op, but others will be forced to return to traditional farming methods. The GG area served by pumps will fall to 80 percent of 1988 levels in 1989, 60 percent in 1990, 40 percent in 1991 and 20 percent in 1992-2007.

services that it provides for their high private rates of return, but the project does not generate enough incremental benefits at private prices to repay the \$1.5 million. With base case yields and prices, project farmers would have to generate 31 million CFAF more in net revenues annually for the entire project to earn a 12 percent rate of return on the \$1.5 million.

## 2. Is the Project Socially Profitable?

If the project is socially profitable then the \$1.5 million investment should be made even if the project is not privately profitable. With social prices replacing private prices, the project generates an internal rate of return of 14.9 percent (Table 3). The social rate is significantly higher than the private rate for two reasons. First, the tax charged on petroleum products creates a large divergence between the private and social cost of diesel fuel. If farmers paid world market prices plus transportation costs for their diesel fuel, their costs of production would be considerably lower and returns on investment would be higher. At the same time, the transport cost is a large component of the delivered cost of diesel fuel so that changes in the world diesel fuel price have a relatively small effect on social profitability. Second, grain prices in the region have been depressed over the past few years due to the availability of subsidized grains. Relief grain in the form of food-for-work rations and for nutritional programs has been in fairly constant supply in the area since 1985. Approximately 2,500 mt of grain were distributed through these and other development programs in the Dire Circle in 1989 (Africare 1989, 20). It is not clear whether local grain prices will remain depressed or if they will rebound to historical levels. This depends largely on world grain stocks (especially rice) and any concessionary terms of purchase which Mali receives for buying grain on the world market. For the social analysis it was assumed that world grain prices would increase at not more than the rate of inflation and local grain prices are expected to stabilize at lower than historical prices.



Table 3: IRRs and NPVs for the \$1.5 million Investment at Social Prices

	IRR	NPV
	(%)	(mill. CFAF)
Base Case	14.9	59.6
Lower Yields	5.0	-152.3
50% Increase in World Fuel Price	14.5	53.4
Lower World Grain Prices	11.3	-14.7

Notes: Base case social prices for grains are 112 CFA/kg for wheat, 105 CFA/kg for millet and 154 CFA/kg for rice. Lower yields are as in Table 2. Lower world grain prices are such as to lead to a 10 percent reduction in social prices in Dire.

Although the project is socially profitable with our base case data, the results are sensitive to parameter changes that are well within the realm of possibility. Hence, our third question, the relative cost of continued support versus famine relief, becomes important.

### 3. Would the Cost of Extended Foreign Support be Less than the Cost of Famine Relief?

The goal of the \$1.5 million investment is to make AP autonomous and sustainable and to stabilize production. Many involved with the project have expressed doubts that these goals can be attained even with three additional years of investment given the current state of cooperative development. Continued large investments are not required to sustain the project, but a small yearly managerial subsidy might be necessary. The farmers particularly need extended support in credit system management and input procurement. We assume that the cost of this assistance is \$100,000 per year for ten years<sup>15</sup>. The specific question we answer is whether this assistance has a net present value greater than or less than the expected cost of famine relief.

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<sup>15</sup>We assume that the \$1.5 million has been received and with it, production is profitable for everyone except the project administration, which needs the \$100,000 per year to hire managerial skills of sufficient level to keep the project operational. In other words, the fees charged to farmers do not cover the cost of this managerial skill.

To answer this question, cost data on famine relief supplied by USAID were used. In 1984/85 the US supplied a total of 54,100 mt of cereals to Mali for free distribution at a total cost of \$23.7 million, including transport to Bamako. The average cost was \$438 per mt. In 1985/86, world grain prices were lower, and the U.S. shipped relief grain to Bamako at an average cost \$367 per mt. Transport of the grain by road to the project area from Bamako adds approximately \$100 per mt to the price. Therefore, relief grain delivered to the project area in 1984/85 cost \$538 per mt and cost \$467 per mt in 1985/86. The administrative region in which the project is located received 29 percent of the food supplied for free distribution by the US in 1984/85.<sup>16</sup> It is important to note that the figures quoted above do not include the high administrative and personnel costs inherent in relief efforts. USAID employees became heavily involved in the relief efforts in 1984/85. In addition to 2 1/2 full time positions assigned to the disaster relief program, in January 1985, "USAID/Mali gave the emergency top priority and diverted staff from ongoing development work to the emergency"<sup>17</sup>. Development workers employed by private voluntary organizations (PVOs) also must often divert their attention from development efforts to relief programs. Other unquantified costs associated with the need for disaster relief are the forgone output of drought victims who are too sick to work and the cost of medicines necessary to sustain life among the sick and hungry. Local production of food would avert these costs for at least the project farmers and their dependents, approximately 5 percent of the population of the Dire Circle.

Crop budgets for AP farmers indicate that the cost of producing grain locally was

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<sup>16</sup>In some cases when food aid arrives late, the cost of transport skyrocket. In June 1985 when the rains started and roads turned to mud, large trucks could no longer travel north, and 750 mt of grain were airlifted to Tombouctou. In Gao, a town north of the AP project, a military raft was airlifted in to ferry relief grains across the river (Baron et al. 1987, 23).

<sup>17</sup>Baron, Albert R., Peter Hammond and H.D. Swartzendruber, 1987, An Evaluation of the African Emergency Food Assistance Program in Mali, 1984-85, A.I.D. Evaluation Special Study No. 49, Washington, D.C., USAID, p 37.

approximately \$280 per mt in 1987 (including returns on the investment and to the farm household).<sup>18</sup> Hence, it is much cheaper to produce grain locally than to import it.

Under current conditions, deliveries of relief food to the Dire Circle may be necessary in one out of every five years, or a total of four years during the 20 year period of analysis. Even in a year of poor rains, AP farmers should be able to produce 1,750 mt of grain if the project remains viable. But if the project collapses, those same farmers will probably not be able to produce more than 600 mt of grain if rains fail.<sup>19</sup> The cost of replacing these 1,150 mt of lost local production with relief food for one year amounts to approximately \$575,000 (based on a figure of \$500 per mt for the grain and transport). As noted above, this is probably a very low estimate for the total opportunity cost of supplying relief food. If this grain had to be supplied by donors four times over the 20 year analysis period, the total cost would be \$2.3 million in current dollars. The present value of the \$2.3 million depends on which years the food is actually needed. When each year of the twenty year analysis period is assigned a probability of 0.2 of requiring famine relief, the present value of the \$2.3 million is \$859,000. The present value of the \$1.0 million AP subsidy (\$100,000 each year for 10 years) is \$565,000. Therefore, in constant dollars, funding for famine relief costs \$294,000 more than subsidizing local production. Thus the subsidy for sustained local production is less costly and much more beneficial to farmers, to the local economy, and to the goal of food security for the Sahel than deliveries of relief food in response to the recurrent crises brought about by drought.

### Indirect Benefits

In addition to the direct project benefits of increased and stable cereal production and larger cash incomes for project farmers, the Activites Paysannes project provides several indirect

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<sup>18</sup>It is assumed that all costs of production are captured in the market price that farmers receive for their grain (85 CFAF/kg converted at the rate of 300 CFAF/\$1).

<sup>19</sup>Based on a without-project scenario which assumes that some farmers are able to continue pump irrigation while others are forced to return to traditional farming methods.

benefits. The irrigation pump mechanics trained by the project also repair cars, motorcycles and mopeds. The training and practice in the use of pumps provided by the project allowed the region to benefit more fully from pumps donated by other development agencies. AP also emphasized literacy and management training which are important for better farm management and the formation of cooperatives, and these skills are easily transferred to other endeavors. In addition, the project improved the health and nutrition of area residents since food was available locally. Relief aid often does not arrive when most needed. Furthermore, the poorest and most desperate people do not have control over distribution and thus often do not receive their share of donated food. Pump irrigation in the area has also benefitted daily agricultural laborers since the larger areas cultivated increases the demand for hired daily labor. When laborers can find work in the area, they are not forced to migrate seasonally to the cities where they exacerbate urban problems of crowding and unemployment.

### Summary and Conclusions

Farmers in the Dire region have enthusiastically embraced diesel pump technology because the current method of allocating project costs has given them substantial private profits, and the pumps have reduced farmers' dependence on erratic rains. As a result of the project, production has increased substantially over what would have been produced using traditional methods. An unintended side effect is a reduced need for famine relief in the area. Given the current constellation of private prices the project is unable to meet AID's criteria of a 12 percent rate of return on the proposed \$1.5 million investment. However, the project is socially profitable because the social price of fuel is substantially lower than the private price, and the social price of the output is somewhat higher than the market price which has been depressed by subsidized distribution of food aid. Furthermore, if the \$1.5 million were provided and repayment not required, the project would have adequate resources to maintain operations, given baseline assumptions about costs.

AP was not initially conceived with the idea that the farmers would eventually manage the project; the government of Mali was to be the managing agency. But when it became apparent that the government staff was not managing the project effectively, local farmers became the proposed recipients of the management structure. In the original project proposal, no thought was given to how project infrastructure and administration duties might be passed on to mostly illiterate farmers. Hence, it should not be surprising that the project might need longer-term support than was originally intended.

If the project collapses, USAID or some donor is likely to spend sums to provide famine relief that are larger than the cost of a subsidy to fund expert managers to keep the project viable. Unfortunately, aid agencies are not accustomed to providing long-term support to ongoing projects. Perhaps their reluctance should be re-evaluated since in some cases famine relief has itself become a long-term commitment, and in at least one instance famine relief is the more costly option.

Technical Appendix to  
**Is there an Alternative to Famine Relief?:**  
**An Example from the Sahel**

These tables are basically printouts of several interlinked Excel spreadsheets. The data were collected primarily at the project site during a visit by the first author in 1987. The spreadsheets are available on diskette on request.

**Table A1: Basic Data**

<b>Yields w/ Proj.</b>	<b>GG Farmer</b>	<b>IM Farmer</b>	
Wheat	2.2	2.6	
Millet	1.6	2	
Rice		2	
<b>Area</b>			
Wheat	170	4	
Millet	170	2	
Rice	0	1	
<b>No. of farmers</b>	340	60	
<b>Pump Info.</b>	<b>World Pr (\$)</b>	<b>Dom. Price (000 CFAF)</b>	
		<b>Private</b>	<b>Social</b>
Deutz pump	8,125	2,600	3,012
Lombardini	17,500	5,600	6,507
Note: see calculations below			
<b>Standard Conversion Factor</b>	0.91		
Off. Ex Rate	300		
Conv.Fact. for transp.	0.76 - see calculations below		
<b>Prices,CFAF/unit</b>	<b>Private</b>	<b>Social</b>	
	Wheat (kg)	85	112
	Millet (kg)	75	105
	Rice (kg)	86	154
	diesel fuel (ltr)	275	114
	engine oil (ltr)	925	380
	labor, male (day)	700	700
	labor, female (day)	600	600
<b>Prices, world, \$/unit</b>			
Wheat (mt)	116		
Millet (mt)			
Rice (mt)	218		
diesel fuel (ltr)	0.13		

**Table A1: Basic Data, continued**

**Pump Amortization, private**

**A. Ganganiberi Cooperative**

3 Lombardini 750 pumps (plus 25% of pump cost added for spare parts)  
Total cost to be financed (000 CFAF) 21,000

Down pay	Interest rate	# of yrs.	Payment/yr. (000 CFAF)
20%	15%	8	3,744

**B. Individual Member Farmers**

1 Deutz pump financed by 4 farmers (plus 25% of pump cost added for spare parts)  
Total cost to be financed: 2,600,000 + 650,000 + 3,250,000

Down pay	Interest rate	# of yrs.	Payment/yr. (000 CFAF)
10%	15%	5	per pump: 873 per farmer: 218

**Pump Amortization, social**

**A. Ganganiberi Cooperative**

3 Lombardini 750 pumps  
Total cost to be financed (000 CFAF) 19,520

Down pay	Interest rate	# of yrs.	Payment/yr. (000 CFAF)
20%	15%	8	3,480

**B. Individual Member Farmers**

1 Deutz pump financed by 4 farmers  
Total cost to be financed: 3,012

Down pay	Interest rate	# of yrs.	Payment/yr. (000 CFAF)
10%	15%	5	per pump: 809 per farmer: 202

**Liter per ha. of diesel fuel for Irrigation**

	wheat	millet	rice
GG	109	64	#N/A
IM	170	100	60

Private Fuel Cost, GG (Mill. CFAF)	8.1
Private Fuel Cost, IM farmer (000 CFAF)	258.5

Social Fuel Cost, GG (Mill. CFAF)	3.3
Social Fuel Cost, IM farmer (000 CFAF)	106.9

**Table A1: Basic Data, continued**

<b>Total Labor Coefficients, w/ project</b>			
days/ha	Wheat	Millet	Rice
<i>done by men</i>			
Land Prep	20	0	0
Level & Ridge	20	10	0
Seed	4	10	10
Irrigate	28	27	10
Weed	0	20	10
<i>Done by women or children</i>			
Bird Contrl	0	0	0
Harvest	30	10	15
Thresh	40	13	15
Transp.	2	2	2
Meal Prep.	10	10	5

<b>Hired Labor Coefficients, w/ project</b>			
<i>done by men</i>			
Land prep	10	6	0
land level	10	10	0
<i>Done by women or children</i>			
harvest	10	6	10
thresh	20	6	5

**Private Cost of Labor (financial outlay - no charge for family labor)**

cfaf/ha	32,000	18,400	9,000
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**Private Cost of Labor (opp. cost charge for family labor)**

cfaf/ha	99,600	67,900	43,200
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**Social Cost of Labor (opp. cost charge for family labor)**

cfaf/ha	99,600	67,900	43,200
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GG Private labor Cost (mil. CFAF)	8.6
GG Social labor Cost (mil. CFAF)	28.5
IM Private labor Cost (000 CFAF)	173.8
IM Social labor Cost (000 CFAF)	577.4

**Calabash farming costs (000 CFAF per ha.) assuming good rain**

seeds	15.0	1.2
tools	1.4	0.7
hired labor	0.0	0.0
meals	8.0	3.0
Total cash outlay	24.4	4.9



**Table A1: Basic Data, continued**

**Major Traded Goods--Border values and CFs**

	Diesel Fuel \$US/litre	Wheat \$US/MT	Rice \$US/Mt
World price	0.13	116	218
Ocean freight & insurance	0.02	20	37
c.i.f. Abj.	0.15	136	255
	CFA/litre	CFA/MT	CFA/Mt
c.i.f. Abj. x OER	45	40,800	76,500
Local port charges	6	5,500	5,500
Transport to border	18	18,725	18,725
Border to Bko(xCFt)	10	9,097	9,097
Bko-marketing costs	7	6,745	9,994
Econ value-Bko	86	80,867	119,816
Transpo to Dire(xCFt)	18	21,626	21,626
Dire-marketing costs	9	9,327	12,871
Econ value-Dire	114	111,820	154,313
Econ value-Bko/litre	86		
Spec CF-Bko (86/210)	0.41		
Econ value-Dire/litre	114		
Spec CF-Dire (113/275)	0.41		

**Major Non-traded Good - Transport; market price (CFA/T/km) 25**

	% of dom price	cost in dom p	CF	Cost in social price
Amortization of Veh.	35	8.75	0.91	7.96
Fuel and oil	20	5.00	0.41	2.05
spare parts & tires	30	7.50	0.91	6.83
labor	10	2.50	0.91	2.28
Taxes	5	1.25	0.00	0.00
Total	100	25.00		19.11
CFt = 19.11/25 =	0.76			

**Table A1: Basic Data, continued**

<b>Pumps</b>	IM farmers	GG Coop
	Deutz pump	Lombardini pump
	\$US	\$US
C.i.f. Abidjan	8,125	17,500
	Note: \$ prices incl. spare parts	
	CFA	CFA
	---	---
C.i.f. Abidjan x OER	2,437,500	5,250,000
Transpo to border	50,000	50,000
Transpo from border to Dire (x CFt = .76)	114,673	114,673
<u>Marketing costs (x SCF)</u>	<u>409,500</u>	<u>1,092,000</u>
Social price	3,011,673	6,506,673

**Table A2: Post-A.P. Project Costs to be Borne by the Cooperative (000 CFAF)**

<b>Personnel</b>	<b>Monthly Cost</b>	<b>Annual Cost</b>
1 credit manager	55	660
4 logistic people (1 head and 3 subordinates)	100	1,200
1 stock manager	35	420
1 coordinator	60	720
1 gaurdian	15	180
<u>1 chauffeur</u>	<u>25</u>	<u>300</u>
<b>Total</b>		<b>3,480</b>

### **Mechanics and Shop**

It is assumed that by moving the shop to Dire, before the end of external financing, the shop will make enough money from pump and other work to be self-supporting.

### **Credit Fund**

It is assumed that profits earned from the sale of diesel fuel and oil will finance the credit fund's expenses including transportation of fuel, maintenance of cisterns and stocks, and loan defaulters. Office supplies, the credit manager's salary and office space will be supplied by the cooperative. (Gross benefits for fuel sales in 1987 equalled 65 CFA/litre for fuel sold on credit.)

### **Infrastructure and Vehicles**

paper and office supplies (credit receipts, etc.)	600
maintenance of buildings, storehouses, etc.	200
maintenance of 2 light vehi21020 (fuel, oil, repairs) at 2000 km/vehicle/mo.	

<u>grain storage costs</u>	<u>100</u>
<b>Total</b>	<b>2,920</b>

<b>Total personnel and infrastructure costs</b>	<b>6,400</b>
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### **Allocation of cost to farmers, by area**

GG area	170	1.84 mil. CFAF
IM Area	420	75.93 000 CFAF/farmer
<b>Total</b>	<b>590</b>	

Data Source: AP project staff.

**Table A3P: GANGANIBERI COOPERATIVE, STATEMENT OF COSTS AND BENEFITS, ACTIVITES PAYSANNES, Financial Analysis, (base yield, base price scenario) (million CFAF)**

**ASSUMPTIONS**

	Wheat	Millet
Output prices (CFA/kg)	85.00	75.00

**Input prices**

Diesel fuel (CFA/l)	275
Engine oil (CFA/l)	925
Pumps	21,000

w/o proj. irr. wheat yld	2.00
w/o proj. irr. millet yld	1.80
trad. wht yld	1.50

	1989	1990	1991	1992	1993	1994 -2000	2001	2002 -2008
Yields (MT/ha)								
Wheat	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Millet	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60

**INFLOWS**

**Gross value of production**

Wheat	31.79	31.79	31.79	31.79	31.79	31.79	31.79	31.79
Millet	20.40	20.40	20.40	20.40	20.40	20.40	20.40	20.40

Total inflow	52.19	52.19	52.19	52.19	52.19	52.19	52.19	52.19
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**OUTFLOWS**

Investment (in pump)	0.00	0.00	0.00	0.00	21.00	0.00	21.00	0.00
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**Pump operating costs**

Diesel fuel	8.09	8.09	8.09	8.09	8.09	8.09	8.09	8.09
Oil	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Spare parts	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Interest on working cap.	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
Subtotal	10.08	10.08	10.08	10.08	10.08	10.08	10.08	10.08

Seeds and tools	4.42	4.42	4.42	4.42	4.42	4.42	4.42	4.42
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Water monitors and mech.	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
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Admin. fee to project	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84
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Labor	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57
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Total outflow	25.46	25.46	25.46	25.46	46.46	25.46	46.46	25.46
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**Table A3P: GANGANIBERI COOPERATIVE, STATEMENT OF COSTS AND BENEFITS, ACTIVITES PAYSANNES, Financial Analysis, (base yield, base price scenario) (million CFAF), continued**

	1989	1990	1991	1992	1993	1994 -2000	2001	2002 -2008
<b>Without Project Calculations</b>								
% area still irrigated	0.80	0.60	0.40	0.20	0.20	0.20	0.20	0.20
Gross Revenue, still irr.	41.48	31.11	20.74	10.37	10.37	10.37	10.37	10.37
Gross Revenue, trad.	4.33	8.67	13.01	17.34	17.34	17.34	17.34	17.34
Tot. Gross Revenue	45.82	39.78	33.75	27.71	27.71	27.71	27.71	27.71
Cost	21.20	16.93	12.67	8.41	8.41	8.41	8.41	8.41
Net Revenue	24.62	22.85	21.07	19.30	19.30	19.30	19.30	19.30
<b>Net benefit before financing</b>								
Total	26.73	26.73	26.73	26.73	5.73	26.73	5.73	26.73
Without project	24.62	22.85	21.07	19.30	19.30	19.30	19.30	19.30
Incremental	2.11	3.89	5.66	7.43	-13.57	7.43	-13.57	7.43
<b>Financing</b>								
Loan receipts	0.00	0.00	0.00	0.00	16.80	0.00	16.80	0.00
Debt service	1.83	0.00	0.00	0.00	3.74	3.74	3.74	3.74
Net financing	-1.83	0.00	0.00	0.00	13.06	-3.74	13.06	-3.74
<b>Net benefit after financing</b>								
Total	24.90	26.73	26.73	26.73	18.79	22.99	18.79	22.99
Without project	24.62	22.85	21.07	19.30	19.30	19.30	19.30	19.30
Incremental	0.28	3.89	5.66	7.43	-0.51	3.69	-0.51	3.69
IRR estimate	0.90							
IRR to the co-op's own resources*	Not possible to calculate							
NPV for the co-op's own resources*	- 25.11 at interest rate 0.12							

\*based on the incremental net benefit after financing

**Table A3S: GANGANIBERI COOPERATIVE, STATEMENT OF COSTS AND BENEFITS, Social Analysis (base yield, base price scenario) (million CFA)**

**ASSUMPTIONS**

	Wheat	Millet
Output prices (CFA/kg)	111.82	105.00

**Input prices**

Diesel fuel (CFA/l)	113.74
Engine oil (CFA/l)	380.00
Pumps	19,520

w/o proj. irr. wheat yld	2.00
w/o proj. irr. millet yld	1.80
trad. wht yld	1.50

	1989	1990	1991	1992	1993	1994 -2000	2001	2002 -2008
Yields (MT/ha)								
Wheat	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Millet	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60

**INFLOWS**

**Gross value of production**

Wheat	41.82	41.82	41.82	41.82	41.82	41.82	41.82	41.82
Millet	28.56	28.56	28.56	28.56	28.56	28.56	28.56	28.56

Total inflow	70.38	70.38	70.38	70.38	70.38	70.38	70.38	70.38
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**OUTFLOWS**

Investment (in pump)	0.00	0.00	0.00	0.00	19.52	0.00	19.52	0.00
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**Pump operating costs**

Diesel fuel	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34
Oil	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Spare parts	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Interest on working K	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Subtotal	5.11	5.11	5.11	5.11	5.11	5.11	5.11	5.11

Seeds and tools	4.42	4.42	4.42	4.42	4.42	4.42	4.42	4.42
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Water monitors and mechanics	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
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Admin. fee to project	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84
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Labor	8.57	8.57	8.57	8.57	8.57	8.57	8.57	8.57
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Total outflow	20.48	20.48	20.48	20.48	40.00	20.48	40.00	20.48
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**Table A3S: GANGANIBERI COOPERATIVE, STATEMENT OF COSTS AND BENEFITS, Social Analysis (base yield, base price scenario) (million CFA), continued**

	1989	1990	1991	1992	1993	1994 -2000	2001 -2008	2002 -2008
<b>Without Project Calculations</b>								
% area still irrigated	0.80	0.60	0.40	0.20	0.20	0.20	0.20	0.20
Gross Revenue, still irr.	56.12	42.09	28.06	14.03	14.03	14.03	14.03	14.03
Gross Revenue, trad.	5.70	11.41	17.11	22.81	22.81	22.81	22.81	22.81
Tot. Gross Revenue	61.82	53.49	45.17	36.84	36.84	36.84	36.84	36.84
Cost	17.21	13.95	10.68	7.41	7.41	7.41	7.41	7.41
Net Revenue	44.61	39.55	34.49	29.43	29.43	29.43	29.43	29.43
<b>Net benefit before financing</b>								
Total	49.90	49.90	49.90	49.90	30.38	49.90	30.38	49.90
Without project	44.61	39.55	34.49	29.43	29.43	29.43	29.43	29.43
Incremental	5.29	10.35	15.42	20.48	0.96	20.48	0.96	20.48
<b>Financing</b>								
Loan receipts	0.00	0.00	0.00	0.00	15.62	0.00	15.62	0.00
Debt service	1.83	0.00	0.00	0.00	3.48	3.48	3.48	3.48
Net financing	-1.83	0.00	0.00	0.00	12.14	-3.48	12.14	-3.48
<b>Net benefit after financing</b>								
Total	48.07	49.90	49.90	49.90	42.52	46.42	42.52	46.42
Without project	44.61	39.55	34.49	29.43	29.43	29.43	29.43	29.43
Incremental	3.46	10.35	15.42	20.48	13.09	17.00	13.09	17.00
IRR estimate	0.90							
IRR to the co-op's own resources*	Not possible to calculate							
NPV for the co-op's own resources* = 107.55 at interest rate			0.12					

\*based on the incremental net benefit after financing

**Table A4P: FARM BUDGET, PUMP-OWNING INDIVIDUAL MEMBER FARMER, Financial Analysis (base yields, base prices scenario) (000 CFA)**

**ASSUMPTIONS**

	Wheat	Millet	Rice
Output prices (CFA/kg)	85.00	75.00	86.00

**Input prices**

Diesel fuel (CFA/l)	275.00
Engine oil (CFA/l)	925.00
Pumps (000 CFA)	812.50

	1989	1990	1991	1992	1993	1994,9, 2004	1995-8, 2000-3 2005-8
Yields (MT/ha)							
Wheat	2.60	2.6	2.6	2.6	2.6	2.6	2.6
Millet	2.00	2.0	2.0	2.0	2.0	2.0	2.0
Rice	2.00	2.0	2.0	2.0	2.0	2.0	2.0

**Gross value of production**

Wheat (4 ha)	884	884	884	884	884	884	884
Millet (2 ha)	300	300	300	300	300	300	300
Rice (1 ha)	172	172	172	172	172	172	172

Total Inflow	1,356	1,356	1,356	1,356	1,356	1,356	1,356
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**OUTFLOWS**

Investment (in pump)	813	0	0	0	0	813	0
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**Pump operating costs**

Diesel fuel	258.50	259	259	259	259	259	259
Oil	29	29	29	29	29	29	29
Spare parts	22	22	22	22	22	22	22
Interest on loans	15	15	15	15	15	15	15
Subtotal	325	325	325	325	325	325	325

**Other operating costs**

Seeds and tools	71	71	71	71	71	71	71
Admin. fee to project	76	76	76	76	76	76	76
Mechanic fee	30	30	30	30	30	30	30
Transport of fuel	6	6	6	6	6	6	6
Labor	174	174	174	174	174	174	174

Total outflow	1494	681	681	681	681	1494	681
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**Net benefit before financing**

Total	-138	675	675	675	675	-138	675
Without project	439	351	246	221	199	199	199
Incremental	-576	324	429	454	476	-337	476



**Table A4P: FARM BUDGET, PUMP-OWNING INDIVIDUAL MEMBER FARMER, Financial Analysis (base yields, base prices scenario) (000 CFA), continued**

	1989	1990	1991	1992	1993	1994,9, 2004	1995-8, 2000-3 2005-8
<b>Financing</b>							
Loan receipts	731	0	0	0	0	731	0
Debt service	218	218	218	218	218	218	218
Net financing	513	-218	-218	-218	-218	513	-218
<b>Net benefit after financing</b>							
Total	376	457	457	457	457	376	457
Without project	439	351	246	221	199	199	199
Incremental	-63	106	211	236	258	177	258
IRR to the farmer's own resources*	2.24						
NPV for the farmer's own resources*	1,393 at interest rate				0.12		

\*based on the incremental net benefit after financing

**Table A4S: FARM BUDGET, PUMP-OWNING INDIVIDUAL MEMBER FARMER, Social Analysis (base yields, base prices scenario) (000 CFA)**

**ASSUMPTIONS**

	Wheat	Millet	Rice
Output prices (CFA/kg)	111.82	105.00	154.31

**Input prices**

Diesel fuel (CFA/l)	113.74
Engine oil (CFA/l)	380.00
Pumps (000 CFA)	752.92

	1989	1990	1991	1992	1993	1994,9, 2004	1995-8, 2000-3 2005-8
<b>Yields (MT/ha)</b>							
Wheat	2.60	2.6	2.6	2.6	2.6	2.6	2.6
Millet	2.00	2.0	2.0	2.0	2.0	2.0	2.0
Rice	2.00	2.0	2.0	2.0	2.0	2.0	2.0
<b>Gross value of production</b>							
Wheat (4 ha)	1,163	1,163	1,163	1,163	1,163	1,163	1,163
Millet (2 ha)	420	420	420	420	420	420	420
Rice (1 ha)	309	309	309	309	309	309	309
<b>Total Inflow</b>	1,892	1,892	1,892	1,892	1,892	1,892	1,892
<b>Investment (in pump)</b>	753	0	0	0	0	753	0
<b>Pump operating costs</b>							
Diesel fuel	107	107	107	107	107	107	107
Oil	12	12	12	12	12	12	12
Spare parts	22	22	22	22	22	22	22
Interest on loans	7	7	7	7	7	7	7
Subtotal	148	148	148	148	148	148	148
<b>Other operating costs</b>							
Seeds and tools	71	71	71	71	71	71	71
Admin. fee to project	76	76	76	76	76	76	76
Mechanic fee	30	30	30	30	30	30	30
Transport of fuel	6	6	6	6	6	6	6
Labor	174	174	174	174	174	174	174
<b>Total outflow</b>	1,257	504	504	504	504	1,257	504
<b>Net benefit before financing</b>							
Total	634	1,387	1,387	1,387	1,387	634	1,387
Without project	901	721	505	454	409	409	409
Incremental	-267	666	882	933	978	225	978

**Table A4S: FARM BUDGET, PUMP-OWNING INDIVIDUAL MEMBER FARMER, Social Analysis (base yields, base prices scenario) (000 CFA), continued**

	1989	1990	1991	1992	1993	1994,9, 2004	1995-8, 2000-3, 2005-8
<b>Financing</b>							
Loan receipts	678	0	0	0	0	678	0
Debt service	202	202	202	202	202	202	202
Net financing	475	-202	-202	-202	-202	475	-202
<b>Net benefit after financing</b>							
Total	1,110	1,185	1,185	1,185	1,185	1,110	1,185
Without project	901	721	505	454	409	409	409
Incremental	208	464	680	731	776	701	776
IRR to the farmer's own resources*	Not possible to calculate						
NPV*	4,872 at interest rate			0.12			

\*based on the incremental net benefit after financing

**Table A5: Social Analysis for the entire project (mill. CFAF)**

	1989	1990	1991	1992	1993	1994	1995-8 2002,3 2005-8	1999, 2004	2001
Incremental Net Benefit Before Financing									
Ganganiberi	5.29	10.35	15.42	20.48	0.96	20.48	20.48	20.48	0.96
60 IM Farmers	-16.03	39.96	52.94	55.97	58.69	13.52	58.69	13.52	58.69
Total Incremental Net Benefit	-10.74	50.31	68.36	76.44	59.65	34.00	79.17	34.00	59.65
Project Admin.	150	150	150	0	0	0	0	0	0
Project Incremental Net Benefit	-160.74	-99.69	-81.64	76.44	59.65	34.00	79.17	34.00	59.65
IRR	0.149								
Net Present Value	59.582 at interest rate 0.12								